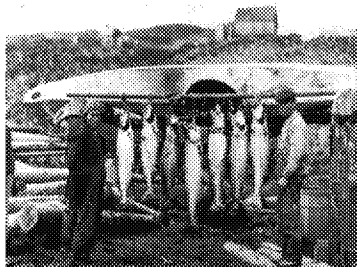
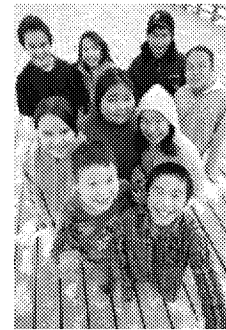
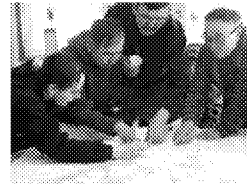
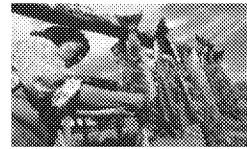


# An Assessment of Ecological Risk to wild salmon from large-scale mining in the Nushagak and Kvichak Watersheds of Bristol Bay, Alaska

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The Nature Conservancy, Alaska Field Office

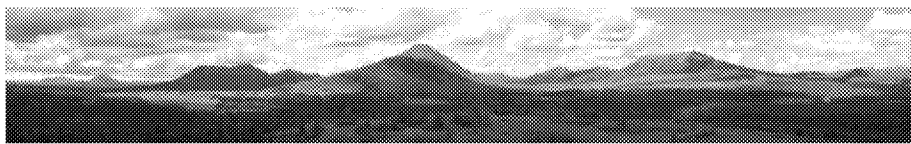
26 January, 2011



Purpose:

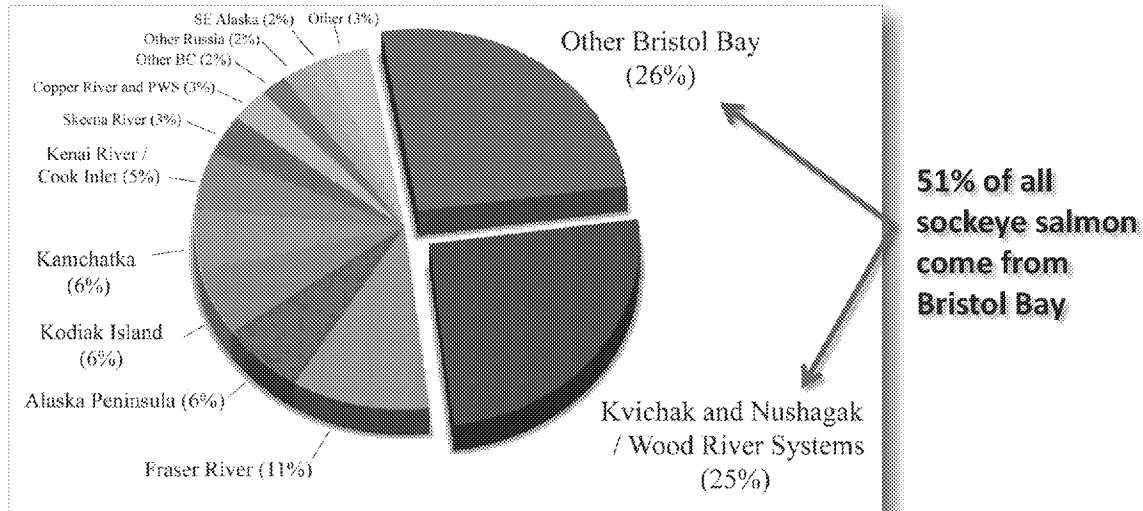
Topics:

Introduction:



## Global Significance:

Bristol Bay produces ~51% of all sockeye salmon on earth



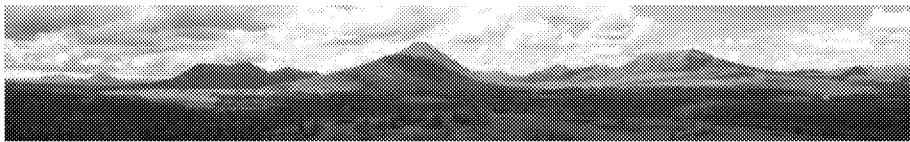
From: Ruggerone et al. 2010. Abundance of adult hatchery and wild salmon by region of the North Pacific. Univ. of Washington, School of Aquatic and Fishery Sciences, Report SAFS-UW 1001, Seattle WA.  
and Pinsky et al. 2009. Range-wide selection of catchments for Pacific salmon conservation. Conservation Biology (23) 681-691.

I'd like to start with a very quick reminder of why Bristol Bay is so important for salmon, and sockeye salmon in particular. A recent analysis by Malin Pinsky at Stanford University used agency reports on escapement and harvest data to estimate run sizes for salmon populations world wide.

These estimates came from diverse sources of varying quality, so we should keep in mind that these are approximations. His analysis estimates that Bristol Bay produces approximately 65% of the world's sockeye ... more than the rest of the world combined.

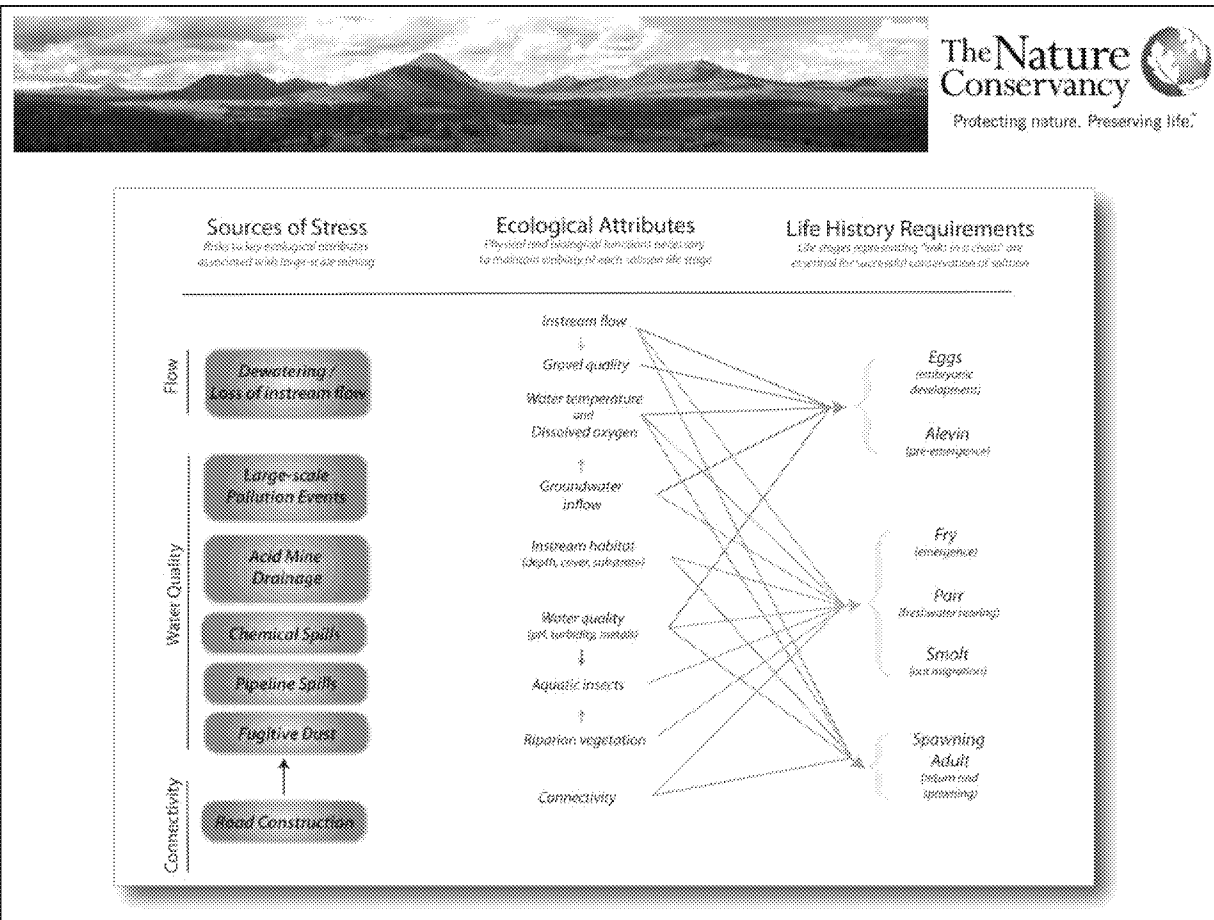
In fact, the Kvichak / Nushagak / Wood River systems produce more than the rest of Alaska outside Bristol Bay or all of Canada.

Take Home Message: If we want to ensure conservation of sockeye salmon in the future, Bristol Bay is the place to do it.

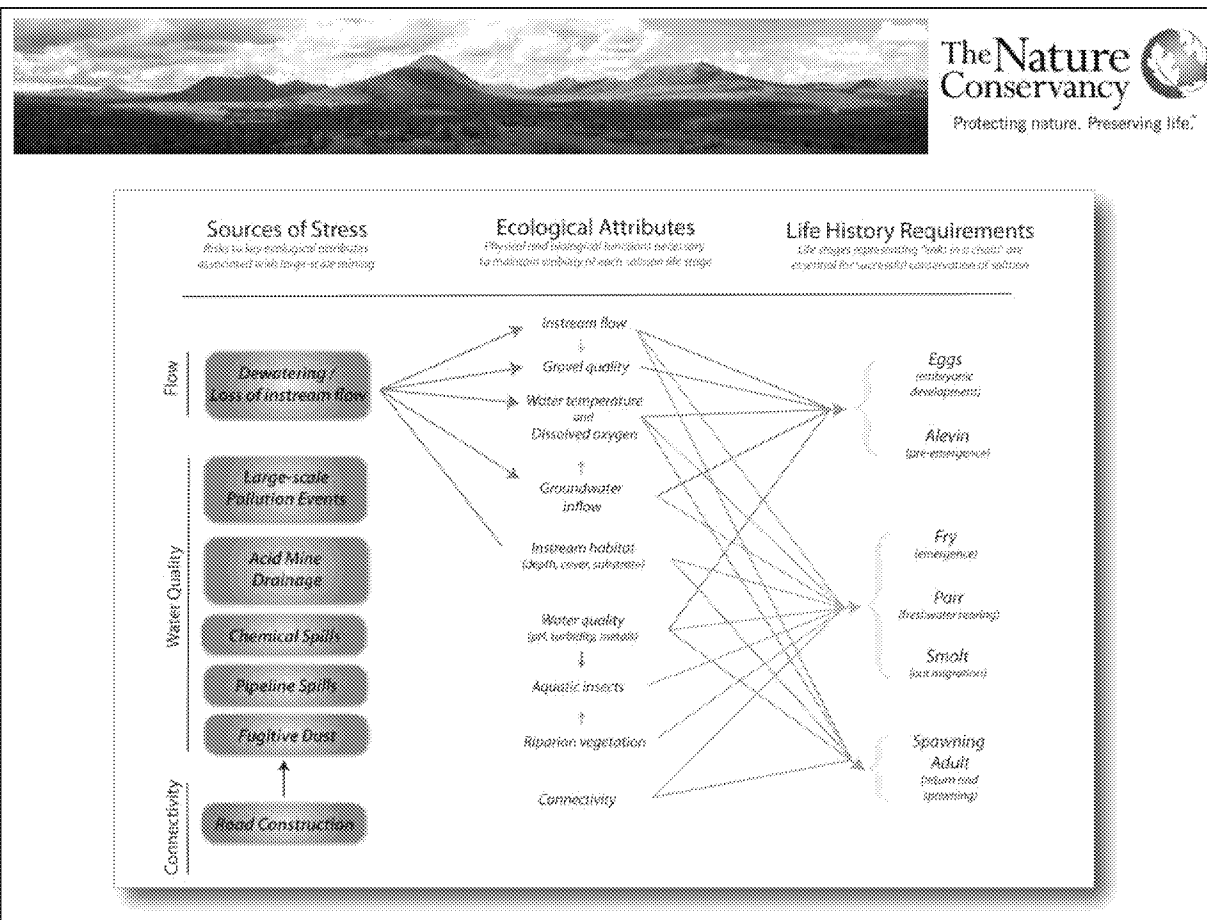


# Ecological Risk Assessment Methods:

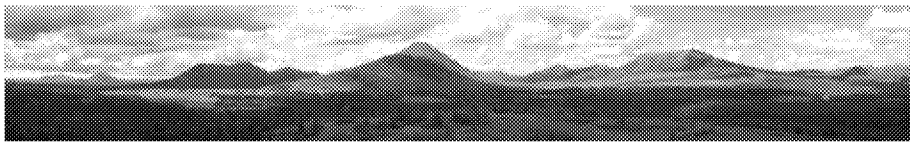
- Large Mine Scenario:
  - Northern Dynasty application for water rights, 2006
- Problem formulation:
  - Physical stressors
  - Chemical stressors
  - Resources at risk
- Literature Review and Data Analysis
  - Estimate future conditions
  - Describe impact on biological resources
- Risk characterization:
  - Evaluate likelihood of adverse effect over time



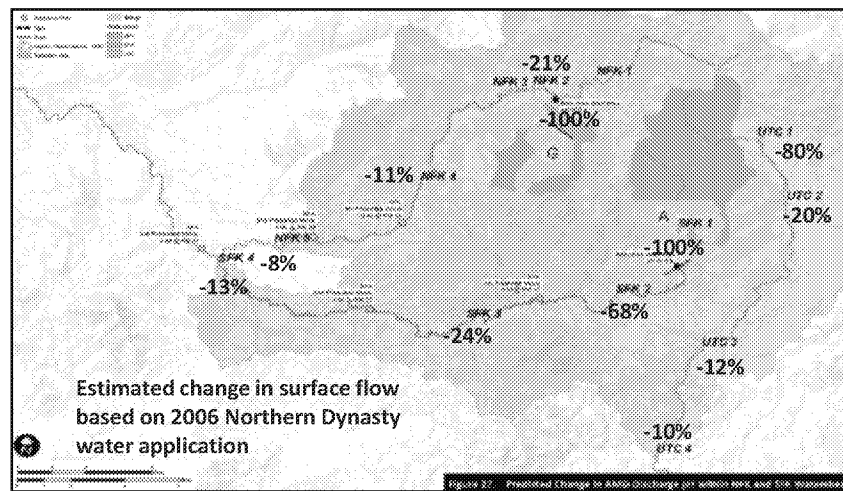
With this framework, we are in a position to evaluate specific risk factors associated with large-scale mining in relation to salmon life stages



For example: Water withdrawals and alteration of groundwater affect (1) both instream flow and groundwater, which also affects (2) gravel quality and (3) regulation of water temperature and dissolved oxygen. These attributes are important to some extent for all life stages, and (4) loss of flow also affects instream habitat which is most important to juvenile rearing and returning adults.

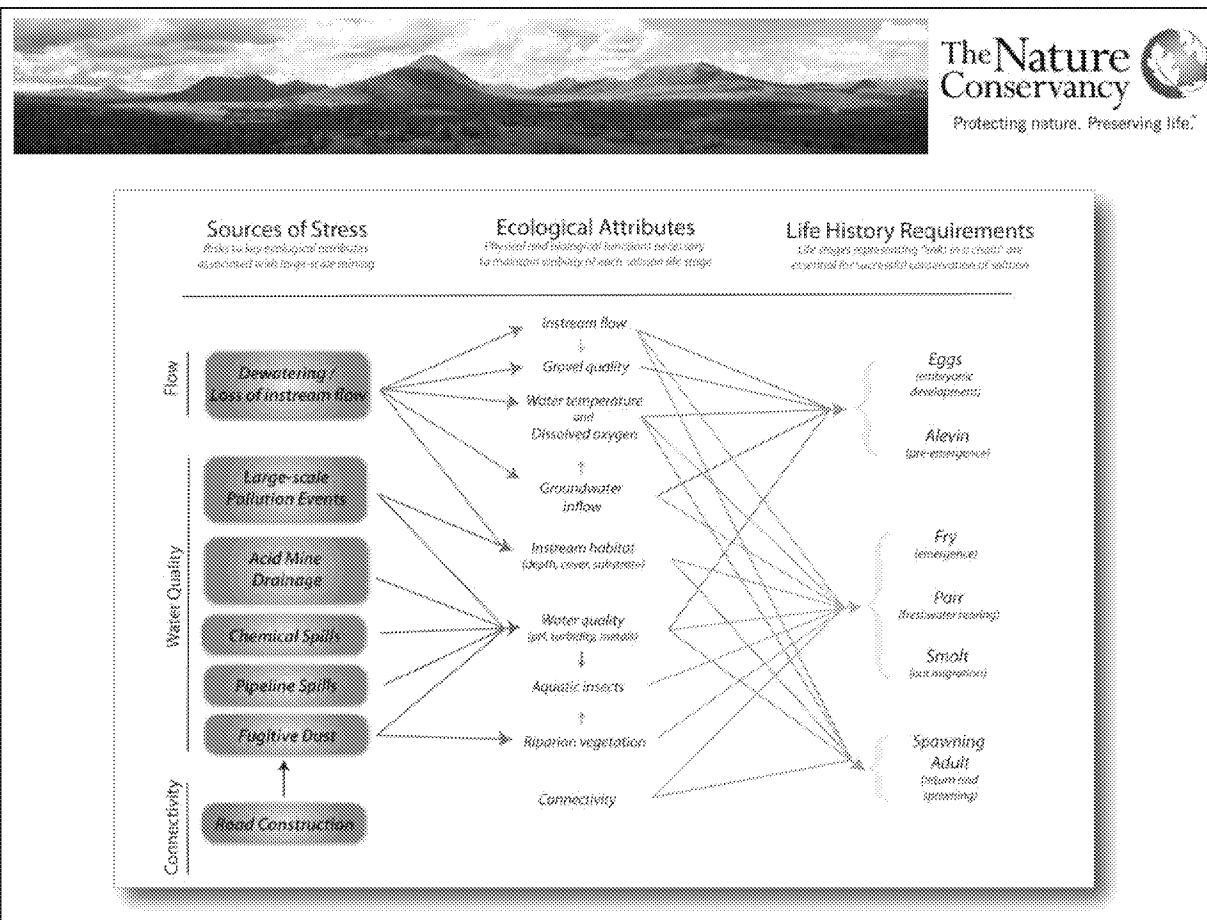


## Loss of Instream flow



**Risk determination:**  
(habitat lost or altered)

- Drainage area lost: 33 miles<sup>2</sup>
- All Streams lost: 68 miles
- Salmon streams lost: 14 miles
- Salmon streams with reduced flow: 78 miles

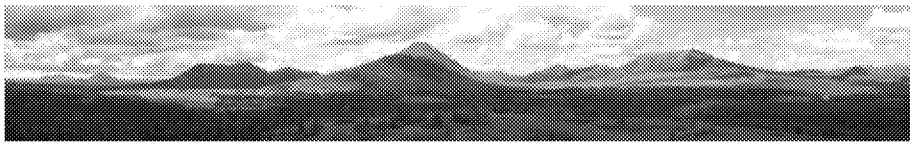


A suite of potential risks to water quality include potential for large-scale pollution events, acid mine drainage, chemical spills, pipeline spills and fugitive dust.

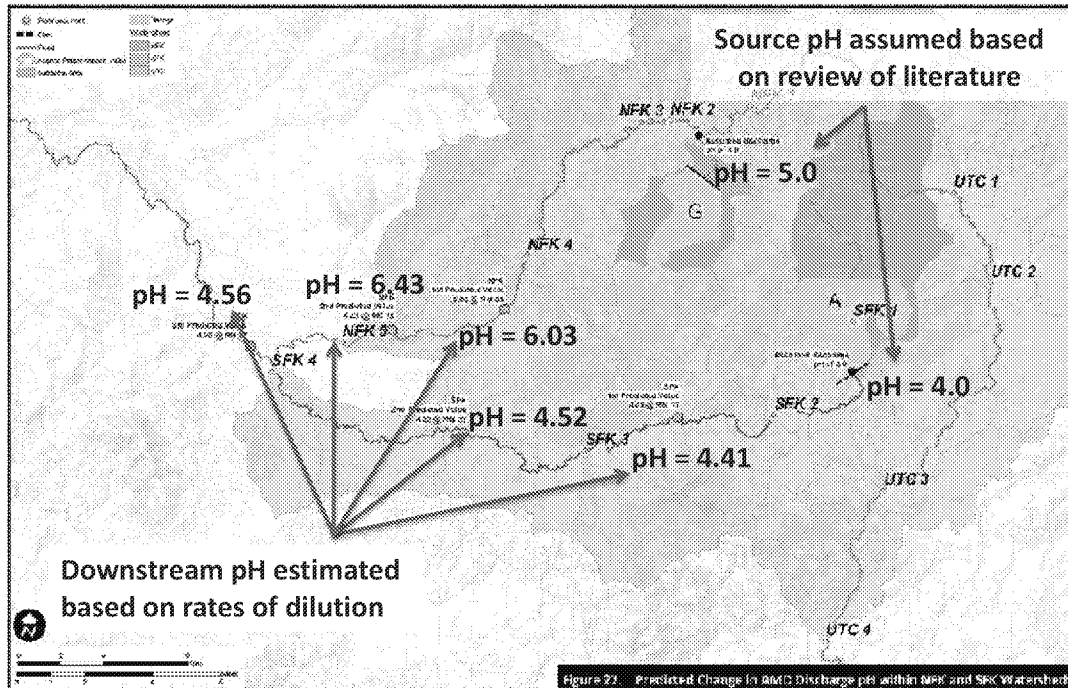
Each potential source (risk factors) differs in regard to their:

likelihood of occurrence and

the scope and severity of impact if an event does occur.



## Acid Mine Drainage



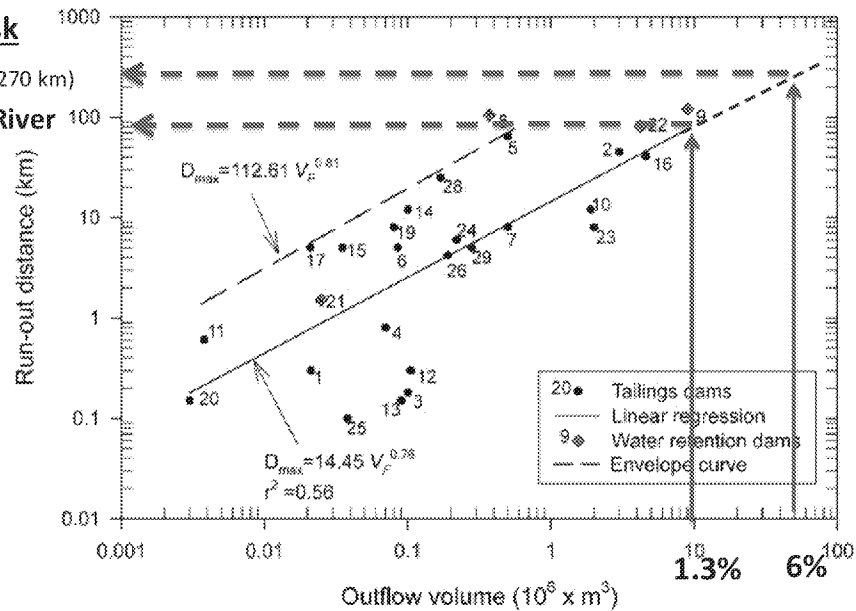


## Risk Scenario: 2 billion-ton tailings impoundment

### Zone of Risk

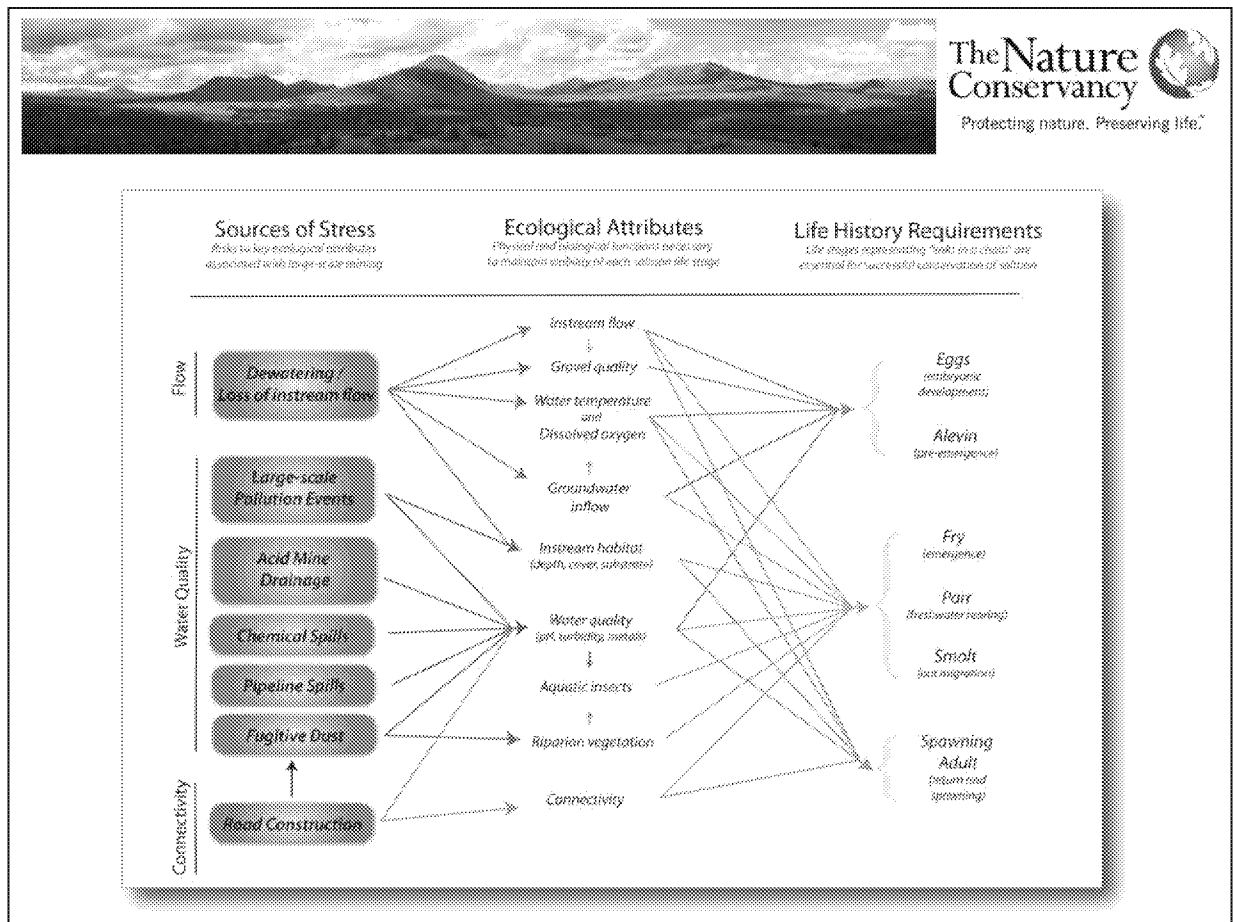
Bristol Bay (270 km)

Mulchatna River (78 km)



Risk scenario based on Northern Dynasty water application, 2006

From: Rico, M., G. Benito and A. Díez-Herrero, 2008. Floods from tailings dam failures. J. Hazard. Materials 154:79-87.

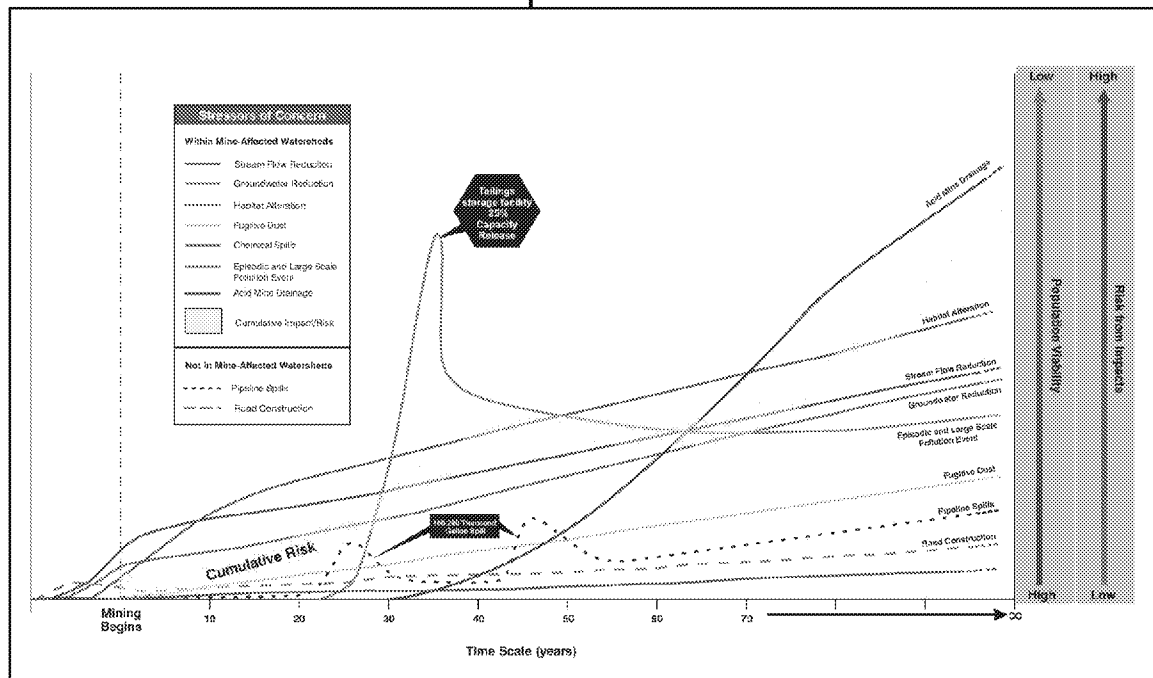


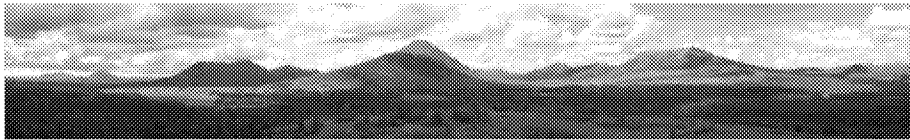
With the addition of issues related to connectivity and water quality associated with construction of roads and potential dust dispersal, this provides a very brief sketch of the issues identified in the Ecological Risk Assessment (ERA).

The power and potential utility of the ERA lies in the literature review and background analysis they have conducted to provide the basis for

- assessment of the direct effects resulting from large-scale mining;
- estimation of likelihood and severity of potential effects; and
- evaluation of how specific changes in these parameters are likely to affect various ecological needs of salmon and other species.

Hopefully, this exercise has helped provide a framework for understanding and learning from the various studies we have completed over the past few years (discussion coming up next), including the Ecological Risk Assessment, to help plan a strategic policy going forward.





## Conclusion:

### TNC Alaska Board of Trustees, Sept 2010:

- Based on our assessment of the risks and state of current, proven mining technology, large scale mining in these critical watersheds at this time presents an inappropriate risk to the salmon systems of the region
- The Conservancy recommends that mining and other activities not be allowed that:
  - Destroy or impair habitat such that sustained abundance is placed at risk
  - Require water withdrawals that exceed ecological flow needs for fish
  - Require active management in perpetuity to avoid contamination
  - Result in acid mine drainage that cannot be eliminated by proven methods at comparable sites and scale
- The Conservancy believes that a very high bar is necessary in this region and the above criteria should form the foundation of that bar